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REEF CORALS FROM THE CALIFORNIA MIDDLE EOCENE*

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Recently a number of reef corals were turned over to the writer by Dr. G. D. Hanna for examination and description. Most of the species were found at Calif. Acad. Sci. Loc. 30667 (from basal *Spiroglyphus* sands, Domengine Reef, S. W. corner Sec. 27 through N. E. $\frac{1}{4}$ of S. E. $\frac{1}{4}$ of Sec. 28, T. 28 S., R. 19 E., Mt. Diablo Base and Meridian, south side of headwaters of Media Agua Creek, Kern County, Calif.), but two were from Loc. 30667A (from top of ridge $\frac{1}{4}$ mi. N. W. of 30667, in a black pebble conglomerate). A single specimen, which is identical with a species from Loc. 30667 (C. A. S.), was from Loc. 1692 (N. W. $\frac{1}{4}$ of Sec. 11, T. 7 N., R. 24 W., San Bernardino Base and Meridian).

Because of better preservation this specimen has been made the holotype of the species *Leptastrea hertleini* Durham, n. sp. No further discussion of this species from Loc. 1692 will be made; all notes refer to its occurrence at Loc. 30667.

At Loc. 30667 and 30667A (apparently about the same horizon) the corals were found weathered out on the ground. Other fossils found include *Turritella lawsoni* Dickerson, *Spiroglyphus* n. sp. (not *S. tejonensis*), *Campanile* n. sp. and *Discocyclus* sp. (very thin). Some *Discocyclus* were adhering to the corals, so that there is no doubt as to the corals belonging with the middle Eocene fauna.

The material examined includes eight identifiable species, all but one (*Astreopora sanjuanensis* Durham) being new. The genera in-

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clude: *Astreopora*, *Astrocoenia*, *Coeloria*, *Favia*, *Leptastrea*, *Oulophyllia*, *Podasteria* (*Manicina* of authors) and *Stylophora*. With the exception of *Astreopora* none of these genera have previously been reported from the Pacific Coast Tertiary. (Species of *Astrocoenia* and *Favia* have been described, but were later referred to other genera.) The recent distribution of these genera is as follows:

Astreopora: Red Sea, Indian Ocean, Australia, Solomon Islands.

Astrocoenia: Atlantic.

Coeloria: Restricted to Indo-Pacific.

Favia: Atlantic and Indo-Pacific.

Leptastrea: Red Sea, Indo-Pacific.

Oulophyllia: Indo-Pacific.

Podasteria: Atlantic, Caribbean.

Stylophora: Red Sea, Indo-Pacific.

From the above list it may be seen that the fauna as represented by these genera has its greatest affinities with the recent Indo-Pacific faunas although there are two definite Atlantic-Caribbean elements in it. This may be contrasted with the conclusion of Vaughan (1917, U. S. Geol. Surv. Prof. Paper 98, p. 367) on the late Miocene or early Pliocene reef coral fauna of Carrizo creek, California, which has its greatest affinities with the recent Caribbean fauna. However, it agrees with his conclusion that the earlier Tertiary faunas contained representatives of 3 recent faunal provinces.

All of these genera are typically reef dwellers, living in shallow tropical seas. At the present time reef corals are not found farther north on the Pacific Coast than Guaymas in the Gulf of California. It therefore appears that this coral fauna would have its modern ecological equivalent at least as far south as Guaymas. In view of the occurrence of reef corals in strata of approximately the same age in northern Washington (about 15 degrees farther north), it is likely that the actual equivalents would be well within the tropics, rather than in the subtropics.

According to Vaughan (1919, Annual Report Smithsonian Inst. for 1917, p. 197) massive reef building corals are largely found in waters 37 meters or less in depth, with a few species extending down to 48 meters. It appears probable therefore that this fauna lived in waters of 37 meters or less depth, for associated with it is *Disco-cyclina* and the large gastropod *Campanile*, both of which are typically reef or shallow water inhabitants.

Astreopora de Blainville

Astreopora DE BLAINVILLE, 1830, Dict. Sci. Nat., vol. LX, p. 348.

Genotype: *Astraea myriophthalma* LAMARCK (1816).

Astreopora sanjuanensis Durham

Astreopora sanjuanensis DURHAM, 1942, Journ. Paleo., vol. 16, No. 1, p. 102, pl. 15, fig. 20; pl. 16, fig. 9.

The specimens at hand vary somewhat from the holotype of this species which comes from the Crescent formation of Washington, but their range of variation includes that found in the type. One specimen is 70 mm. high by nearly 60 mm. in its greatest diameter. Many calices are 2.5 mm. in diameter, but some are around 1.5 mm. which size approximates that on the Washington specimen. The septa are thin and have the same pattern but in some corallites extend closer to the center of the calice.

Hypotype: No. 5908 (Calif. Acad. Sci., Paleo. Type Coll.), from Loc. 30667 (C. A. S.).

The species is found in Washington in beds correlated by Berthiaume (1938, Journ. Paleo., vol. 12, p. 495) with the Capay of California.

Astrocoenia Milne Edwards and Haime

Astrocoenia MILNE EDWARDS and HAIME, 1848. Compt. Rend. Acad. Sci., Paris, t. XXVII, p. 469.

Genotype (monotypic): *Astraea numisma* DEFRANCE (1826).

Astrocoenia dilloni Durham, new species

PLATE 44, fig. 3

Corallum small, 10 by 18 mm., subplanate. Calices small, from 1.3 to 2.5 mm. in diameter, maximum depth 0.5 mm. Maximum thickness of thecal wall 0.4 mm., between adjacent calicular cavities, usually less. Ten prominent septa reach columella, a smaller septum between each pair apparently not reaching columella. Major septa fused to the sunken styliform columella which is usually about one-fourth the diameter of the calice. Major septa with about five poorly defined denticles. Septal faces granulate.

Holotype: No. 7724 (Calif. Acad. Sci., Paleo. Type Coll.), from Loc. 30667A (C. A. S.).

This species may be distinguished from other American *Astrocoenias* by the 10 major septa.

Coeloria Milne Edwards and Haime

Coeloria MILNE EDWARDS and HAIME, 1848. Compt. Rend. Acad. Sci., Paris, t. XXVII, p. 493.

Genotype (monotypic): *Madrepora daedalea* ELLIS and SOLANDER 1786, *non* Forskål 1775 (see Wells, 1936, Am. Journ. Sci., vol. XXXI, p. 104).

Coeloria wellsii Durham, new species

PLATE 44, figs. 2, 13, 14

Corallum massive, explanate. Valleys usually short and separate, 5 to 8 mm. wide, up to 20 mm. long, averaging around 10 mm. long, 1 to 3 mm. deep. Collines narrow and sharp. Septa about 20 to centimeter, alternates usually incipient only, extending up and across colline but worn at top. Septal denticulations fine. Septa in some valleys as thick as their interspaces but in others considerably thinner. Columella small, trabecular.

Holotype: No. 5914 (Calif. Acad. Sci., Paleo. Type Coll.), from **Loc. 30667** (C. A. S.).

The general form of the corallum and separate valleys closely resembles the recent *Coelorias* but the closely set septa readily distinguish it.

Favia Oken

Favia OKEN, 1815, Lehrb. Naturgesch, Th. 3, Abt. 1, p. 67.

Genotype: *Madrepora fragum* ESPER (1795).

Favia hannai Durham, new species

PLATE 44, figs. 9, 10, 11

Corallum massive, upper surface convex, 45 mm. in diameter, 25 mm. high, attached by pedicel. Corallites distinct, irregular in shape, and separated from 2 to 5 mm., usually 3. Calices up to 3 mm. deep, a slightly raised edge. Costae corresponding to septa, extending out into intercalicular area 1 to 2 mm. Septa thin, 25 to 30 to a mm., alternate septa thicker. Septal denticulations 2 or 3 to a mm., rounded. Columellar area small, apparently formed by trabecular fusion of inner ends of major septa.

Holotype: No. 7730, paratypes Nos. 7731, 7776 (Calif. Acad. Sci., Paleo. Type Coll.), Univ. Calif. Mus. Paleo. No. 30641, from **Loc. 30667** (C. A. S.).

This species is not closely allied to any known to the author. The septa are much closer together and thinner than those of any available description.

One poorly preserved specimen has a diameter of 10 centimeters.

Leptastrea Milne Edwards and Haime

Leptastrea MILNE EDWARDS and HAIME, 1848. Compt. Rend. Acad. Sci., Paris, t. XXVII, p. 494.

Genotype: *Leptastrea roissyana* MILNE EDWARDS and HAIME (1850).

Leptastrea hertleini Durham, new species

PLATE 44, figs. 1, 4, 5

Corallum massive, flattened, more or less eroded. Holotype 87 x 52 x 33 mm. Intercorallite furrows indeterminate, corallites not projecting. Peritheca dense. Calices rounded, 2 to 3 mm. in diameter, usually about 0.5 mm. deep to top of columella. Septa in three cycles, swollen in theca, becoming thinner towards columella. Third cycle not always reaching columella. Septa two-thirds as thick as interspaces next the wall, primaries thickest. In cross section columella one-third to one-half the diameter of corallite, projecting slightly above bottom of calice. Septa not continuous from one calice to next, apparently not exsert.

Holotype: No. 5911 (Calif. Acad. Sci., Paleo. Type Coll.), from Loc. 1692 (C. A. S.).

Paratype No. 5913 occurs at loc. 30667 (C. A. S.) but the specimen is poorly preserved. It seems to have slightly deeper calices than the holotype, but it is partially recrystallized. Because of the poor preservation it cannot be determined whether the differences are real or due to weathering.

No comparable species is known as yet from the Pacific Coast Tertiaries.

Oulophyllia Milne Edwards and Haime

Oulophyllia MILNE EDWARDS and HAIME, 1848. Compt. Rend. Acad. Sci., Paris, t. XXVII, p. 492.

Genotype (monotypic): *Meandrina crispa* LAMARCK (1816).

Oulophyllia californica Durham, new species

PLATE 44, figs. 7, 12

Corallum 55 mm. in diameter, about 25 mm. high, broadly pedicellate. Valleys 5 to 14 mm. wide, up to 5 mm. deep, distinct calicinal centers. Collines thin and narrow above, not grooved. Septa thin, about 16 to a centimeter, every alternate one heavier and reaching columella. Upper half of principal septa narrow, lower

half broad. Septal denticulations apparently coarse. Columella distinct, trabecular, 1.5 mm. to 2 mm. in diameter. Fine costae, about 20 to a centimeter, on external surface.

Holotype: No. 5918 (Calif. Acad. Sci., Paleo. Type Coll.), from **Loc. 30667** (C. A. S.).

The holotype generally resembles the recent *O. crispa* (Lamarck), but the latter species has only 9 to 10 septa to the centimeter.

Podasteria Ehrenberg

Podasteria EHRENBURG, 1834; Corallenth., des Rothenmeeres, p. 326.

Genotype (monotypic): *Manicina gyrosa* EHRENBURG 1834. =

Podasteria mayori WELLS 1936. *non Madrepora gyrosa* ELLIS and SOLANDER 1786, pl. 51, fig. 2. (See WELLS, 1936, Am. Journ. Sci., vol. XXXI, p. 125).

Podasteria churchi Durham, new species

PLATE 44, fig. 6

Corallum small, nearly explanate, nearly 45 mm. in diameter. Lower surface with broad pedicel, no calices. Colline somewhat variable, at times moderately wide and grooved, at others rather narrow and sharp with no trace of groove. Valleys irregular, broad, of varying width, from 4 to 12 mm. wide, up to 3 mm. deep. Septa thin, about 20 to a centimeter. Alternate septa may be less prominent than rest. Septal denticulations nearly 3 to a mm. Columella trabecular, from 0.8 to 1.7 mm. wide. Presence or absence of costae indeterminate on holotype.

Holotype: No. 7725 (Calif. Acad. Sci., Paleo. Type Coll.), paratype No. 5917 from **Loc. 30667** (C. A. S.).

This species resembles the recent *P. areolata* (Linnaeus) but differs from it in the slightly greater number of septa to a centimeter and the lesser depth of the valleys.

Stylophora Schweigger

Stylophora SCHWEIGGER, 1819 (part). Beobacht, Naturhistor-Reisen, Tab. 5.

Genotype: *Madrepora pistillata* ESPER. (1797).